

REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the Office Action of June 12, 2009 is respectfully requested.

In the outstanding Office Action, the Examiner rejected all of the previously-pending claims in view of the prior art. In particular, the Examiner rejected claims 32 and 33 as being anticipated by the Oberlitner reference (USP 7,294,244); rejected claims 35-39 as being anticipated by the Sakaki reference (USP 6,875,333); rejected claims 22-25 and 27-31 as being unpatentable over the Wang reference (U.S. Publication 2002/0153246); and rejected claims 22, 26, and 34 as being unpatentable over the Oberlitner reference. However, each of independent claims 22, 32, 35, and 38 has now been amended so as to clarify the distinctions between the present invention and the prior art. For the reasons discussed below, it is respectfully submitted that all of the amended claims are now clearly patentable over the prior art of record.

A discussion of the features and advantages of the present invention as recited in the amended claims will now be provided below with reference to various portions of the present application. However, reference to any specific sections of the specification or drawings is provided only for illustrative purposes, and is not intended to otherwise limit the scope of the claims to any particular embodiments.

Amended independent claim 22 is directed to a plating apparatus that comprises a ring-shaped nozzle pipe 220 *in a plating tank* 186 so as to be immersed in the plating solution held in the plating tank 186, as illustrated in Figure 3. The ring-shaped nozzle pipe 220 is shaped to extend along an outer profile of the workpiece W, and (as shown in Figure 4) has a plurality of injection nozzles 222 for injecting the plating solution toward the surface of the workpiece W held by the holder 160 to supply the plating solution into the plating tank 186 (see page 20, lines 2-14 of the substitute specification submitted March 5, 2009). As a result of this arrangement, the plating speed is increased without reducing the quality of the plated film, and the uniformity of the film thickness of the plated film on the surface of the substrate is greatly improved (see page 21, lines 8-15 of the substitute specification).

The Wang reference teaches an apparatus for electro-polishing metal interconnections on a semiconductor device including liquid mass flow controllers 21, 22, 23 for controlling flow of a solution into inlets 4, 6, 8 of a polishing receptacle 100 (see paragraph [0113] on page 5 of the

Wang reference). Although unclear, it *appears* that the Examiner may be taking the position that any of inlets 4, 6, or 8 correspond to the nozzle pipe of the present invention, while the liquid mass flow controllers 21, 22, 23 correspond to the injection nozzles of the present invention. However, the Applicants disagree, and note that independent claim 22 has now been amended to further clarify the present invention.

Firstly, independent claim 22 now clearly recites that the nozzle pipe (and, thus, the injection nozzles of the nozzle pipe) is *in the plating tank* to be immersed in the plating solution. In contrast, the liquid mass flow controllers 21, 22, 23 are clearly not in the plating tank 100 of the Wang reference.

Furthermore, as noted above, it is not clear how the Examiner is interpreting the Wang reference to teach a nozzle pipe, although the Examiner acknowledges that the Wang reference does not teach a *ring-shaped* nozzle pipe. Nonetheless, the Examiner appears to be dismissing the recited shape of the nozzle pipe as merely “relative dimensions” which are not entitled to patentable weight. The Applicants strongly disagree with the Examiner’s position. As explained above, there are significant reasons for providing a *ring-shaped* nozzle pipe, including greatly improved plating performance, and the shape of the nozzle pipe is not equivalent to a mere difference in “relative dimensions” as apparently asserted by the Examiner. Thus, this limitation is entitled to patentable weight, and further distinguishes amended claim 22 from the prior art including the Wang reference.

Finally, independent claim 22 clearly recites that the nozzle pipe *has a plurality of injection nozzles*. Again, it is not entirely clear how the Examiner is interpreting the Wang reference as teaching a ring-shaped nozzle pipe and injection nozzles, but it is clear that the Wang reference does not teach a ring-shaped nozzle pipe *having a plurality of injection nozzles*.

Because of the absence of the features noted above, it is submitted that the Wang reference does not anticipate or even render obvious amended independent claim 22. Accordingly, it is respectfully submitted that amended independent claim 22 and the claims that depend therefrom are clearly patentable over the prior art of record.

Amended independent claim 32 is directed to a plating apparatus that comprises a stirring mechanism 620 having a stirring vane 619 with irregularities 619a on at least one side thereof, as illustrated in Figure 16. The irregularities 619a comprise a succession of triangular (Fig. 17A) or

rectangular (Fig. 17B) saw-tooth irregularities (see page 32, line 21 through page 33, line 4 of the substitute specification filed March 5, 2009). As a result of this arrangement, uniform swirls are formed within the plating solution by the irregularities of the stirring vane so that the plating solution will contact the workpiece W in a more uniform manner, thereby improving the film thickness of the plated film (see page 33, lines 6-17 of the substitute specification).

The Oberlitner reference teaches a workpiece processing tool including a paddle 132 which can have a plurality of fluid channels 154 with fluid delivery ports 150 formed therein (see Figures 18 and 19, and 29; and column 12, lines 61-65 of the Oberlitner reference). The Examiner asserts that the fluid ports 150 correspond to the irregularities of the present invention. However, the Oberlitner reference does not teach or suggest irregularities that comprise a succession of *triangular or rectangular saw-tooth irregularities*, as now recited in amended independent claim 32. Therefore, it is submitted that amended independent claim 32 is not rendered obvious by the Oberlitner reference or the other prior art of record. Consequently, it is submitted that amended independent claim 32 and the claim that depend therefrom are now in condition for allowance.

Amended independent claim 35 is directed to a plating apparatus comprising a stirring mechanism 620 having a plurality of stirring vanes 619. As illustrated in Figures 19A and 19B, the stirring vanes 620 are actuatable by respective independent drive mechanisms *each having an independent drive source* 623-1 (see page 34, lines 4-23 of the substitute specification filed March 5, 2009). As a result of this arrangement, the movement of each stirring vane can be adjusted to modify the flow of plating solution over the surface of the workpiece W as necessary in order to form a plated film with a more uniform film thickness (see page 34, lines 24-31 of the substitute specification).

The Sakaki reference teaches a plating apparatus for a wafer including a first stirrer (or first vane) 40 and a second stirrer (or second vane) 80. In rejecting previously-pending independent claim 35, the Examiner asserted that the Sakaki reference teaches independent drive mechanisms. However, the Sakaki reference teaches that the first stirrer 40 and the second stirrer 80 are both driven by the *same* driving shaft 11. In other words, both stirring vanes 40 and 80 of the Sakaki reference have the *same drive source*, and the Sakaki reference does not teach or suggest a plurality of stirring vanes actuatable by independent drive mechanisms, *each having an independent drive source*. Therefore, the Sakaki reference does not anticipate or even

render obvious amended independent claim 35. Consequently, it is respectfully submitted that amended independent claim 35 and the claims that depend therefrom are clearly patentable over the prior art of record.

Amended independent claim 38 is directed to a plating apparatus that also comprises a stirring mechanism having a stirring vane 626. The stirring vane 626 is oriented such that a plane of the stirring vane 626 forms an angle with respect to a plane perpendicular to the surface of the workpiece W (see Figure 23). Furthermore, the stirring mechanism is operable to vary the angle of the plane of the stirring vane 626 with respect to the plane perpendicular to the surface of workpiece W as the stirring vane 626 reciprocally moves by angular movement of the rotational shaft 627 about the longitudinal access of the rotational shaft (see comparison of Figure 23 with Figure 24; and page 35, line 23 through page 36, line 3 of the substitute specification submitted March 5, 2009). As a result of this arrangement, the flow of the plating solution over the workpiece can be made more uniform so as to improve the film thickness uniformity on the surface of the substrate (see page 36, lines 3-19 of the substitute specification).

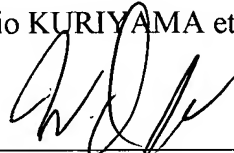
In the outstanding Office Action, the Examiner asserted that the stirring vane 41 of the Sakaki reference is operable to form an angle with respect to the surface of the workpiece which is variable as the stirring vane reciprocally moves and the direction in which the stirring vane is changed by angular movement of the rotational shaft, and referred to Figures 3a-3e of the Sakaki reference. However, the distinguishing feature recited in independent claim 38 has now been clarified in view of the Examiner's interpretation. It is submitted that the Sakaki reference does not teach or suggest the orientation of a stirring vane relative to a plane perpendicular to the surface of the workpiece. Moreover, it is submitted that the Sakaki reference clearly does not teach a stirring mechanism operable to vary the angle of the plane of the stirring vane with respect to the plane perpendicular to the surface of the workpiece, as now recited in amended independent claim 38. Therefore, the Sakaki reference does not render obvious amended independent claim 38. Consequently, it is respectfully submitted that independent claim 38 and the claims that depend therefrom are clearly patentable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. However, if the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact the Applicant's undersigned representative.

Respectfully submitted,

Fumio KURIYAMA et al.

By



W. Douglas Hahm

Registration No. 44,142

Attorney for Applicants

WDH/kh
Washington, D.C. 20005-1503
Telephone (202) 721-8200
Facsimile (202) 721-8250
September 14, 2009